eg. A light bulb is connected to a 6.0V battery. if a current of 450mA goes through the bulb, what is

a) resistance of the filament,
R = V/I = 6/0.45=13.3333 = 13Ω
V=IR or I=V/R

b) the amount of charge going through in 5.0s
I=q/t q= It = 0.45C/sx5s=2.25 C

c) the energy given off as heat (V=energy/charge)
energy = Vq = 6J/C x2.25C=13.5 J

d) power dissipated by the resistor
P=energy/time = 13.5J/5.0s=2.7 W

e) derive equations for the power dissipated by the circuit element
P=energy/time = Vq/t = VI
$P=VI = I^2R = V^2/R$

eg. The kettle is rated at 1200W for 120V wall socket.

a) what is the resistance of the heating element?
$P=V^2/R$ $R=V^2/P$ = 120^2 J^2/C^2/1200J/s =12 Ω
Js/C^2 =Ω

b) What is the current through the element?

P=VI I= 1200/120=10 A
This is the limit for most household fuses, more

current causes the fuses to either flip or burn out to protect your house from fires.

c) time to heat 500ml of water (500g) from 15.0º to 100.0ºC c=4180J/kgK 4.180 J/gK

Q=mcΔT = Pt t = 0.5kgx4180J/kgKx(100ºC-15ºC)/1200W= 148.0417=148.0417 148.0417-120=28.0417
2minutes and 28 seconds

d) what is the efficiency of the kettle if it takes 3.0minutes to boil the water?
efficiency = Pout/Pin x 100%
= (Q/t)/1200
= 0.5kgx4180J/kgKx(100ºC-15ºC)/(3x60)
= (0.5x4180x(100-15)/(3x60))/1200=0.8225
82% efficient
where did the lost energy go?
heat the metal and the air, some vapourization, sound into the air

Resistivity
What physical factors influence the resistance of a wire or circuit element?

Type of material (density, free electrons in orbital shells, temperature dependence)
quantify as resistivity, ρ, find it in tables

ρ ρ

on p465

$\rho_{Cu} \approx 1.68 \times 10^{-8}\ \Omega m$

$\rho_{Al} \approx 2.65 \times 10^{-8}\ \Omega m$

Resistance is also determined by the length of the wire and the cross-sectional area of the wire.

$R = \rho L/A$

eg. you have a wire with length 3.0m and radius 1.0 mm. What is the resistance of the wire if it is made of a) Cu b) Al?

p477 Q9, 3, 11, 13, 8, 29, 31

$\theta_c = \sin^{-1} \frac{n_2}{n_1}$ $\frac{1.33}{1.56}$

$$\overline{E_k} = \frac{3}{2} kT$$

$$p = \frac{F}{A} \qquad W = Fd$$

$$W = pA(d)$$

d = ΔL

$$W = p\Delta V$$

area of p-V graph

$$A \to B = \frac{1}{2}(2+6)(10-6)$$

$$= 20\,kJ$$

$$B \to C = 0 \quad (0\,\Delta V)$$

$$C \to A = 2(6-10)$$

$$= -8\,kJ$$

$= -8\ kJ$

$20 - 8 = \boxed{12\ kJ}$